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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Appointment of a Committee of Reception by the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

The following named members of this Association are appointed and respectfully requested to serve as a Committee of Reception, whose duty shall be to call upon all foreign gas engineers visiting our country during the continuance of the World's Fair at Chicago, whose names and addresses may be obtained, and to introduce them to other members of our profession, see that they obtain permits to visit the neighboring gas works and other objects of interest, and generally to make their stay in New York as pleasant as possible, and when they leave for Chicago, to give them letters of introduction to the Committee of Arrangements at Chicago: Messrs. Wm. Henry White (chairman), Eugene Vanderpool, William H. Bradley, Fred. S. Benson, William R. Beal, Thos. F. Rowland, Jr., Fred. W. Floyd and Oscar Weber.

The Guild of Gas Managers and the Society of Gas Lighting are respectfully requested to co-operate with this committee in extending hospitality to our visiting professional brethren.

A. B. SLATER, JR., Secretary. A. E. BOARDMAN, President.

[OFFICIAL NOTICE.]

The American Gas Light Association's Greeting to European Gas Engineers.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

To the European Gas Engineers—Greeting: The American Gas Light Association will hold its 21st annual convention in the city of Chicago, beginning on the date of Wednesday, October 18th, 1893. It would give the members of the Association great pleasure to meet there as many of the European gas engineers and managers as can make it convenient to be in attendance at the World's Fair at that time. It is suggested that all contemplating visiting the Fair arrange their visits so as to be in Chicago, if possible, at the time of this convention, when they will be most cordially welcomed by the Association and invited to attend the sittings of the body and participate in its discussions of papers presented.

Those engineers who cannot conveniently visit the World's Fair at that time, but must choose some other date, are respectfully requested to send their names and addresses, as soon as they arrive in America, to the AMERICAN GAS LIGHT JOURNAL, No. 32 Pine street, New York City, so that a committee from the Association may be made aware of their presence, and when they may be met, so that they may form the acquaintance of their professional brethren in this country and be made to feel less like a "stranger in a strange land."

A. B. SLATER, JR., Secretary. A. E. BOARDMAN, President.

BRIEFLY TOLD.

TAKING CARE OF EUROPEAN GAS ENGINEERS.—Following the very thoughtful and considerate action of the American Gas Light Association, as shown in the above official circular from its chief executives, we venture the opinion that the Association's Committee of Reception will be frequently called upon in the next half year to carry out the purposes for which they have been appointed, as we have advices from many of our own subscribers in foreign countries of their intention to visit America this summer and fall, the main object of their visit to be, of course, an inspection of the amazing Exhibition now underway in the metropolis of the West. Every day the exceeding great pity that the gas interests of America have not a separate representation at the

World's Fair is more plainly apparent, and we fear the markedness thereof will be more pronounced as the Fair days pass by; but the bounden duty of everyone now is to see to it that the hard side of the regrettable position is toned down as much as possible. The pronouncements of the American Association will go far towards amending one displeasing feature of the omission to have separate representation, in that our foreign brethren, be they European, South American, Australian, or from what portion of the globe they hail, will be assured of a fraternal reception and treatment that will go far toward assisting them in attaining the fullest measure of comfort, instruction and benefit from their visit to the States. The JOURNAL holds itself in readiness to assist in this pleasantly fraternal work, nor can any draft on our resources in this regard be too great to pass unhonored. We repeat, this action on the part of the American Association is graceful, considerate and fraternal.

THE PACIFIC COAST GAS ASSOCIATION.—We are in receipt of a circular letter signed by Messrs. J. B. Crockett and E. C. Jones, and issued from the office of the San Francisco Gas Light Company, on May 26th, which contains the satisfactory assurance that the number of replies received in response to the letter of April 13th last, which letter was framed with the purpose of testing the feeling entertained by the gas companies towards the prospect of founding a Gas Association on the Pacific Coast, have been sufficiently numerous "to make the formation of the Pacific Coast Gas Association an assured success." This is as it should be, and we have no doubt whatever that the "baby" will grow and prosper, for the field from which the youngster can draw sustenance is a broad and fertile one. The current letter states that the first meeting will be held in San Francisco, on Tuesday and Wednesday, July 11th and 12th, and although it is not so expressed, we presume the initial sessions will be brought off on the premises of the San Francisco Gas Light Company. Those who have signified their intention of taking membership in the Association are urged to apply their "individual efforts towards making the first meeting interesting and instructive," which, of course, can best be done, as the circular suggests, "by writing a paper, presenting your ideas and experience in some branch of the gas business, or by sending inquiries for the Question Box." The circular does not fail to intimate that personal attendance is the prime requisite, however, for a good beginning, "as the future of the proposed Association depends in a great measure on the success of the first meeting." Messrs. Crockett and Jones are to be congratulated on the solid measure of reward so far received by them in return for their labors at organization, and we confidently look forward to a rousing good meeting on the Coast in mid July.

MR. MCMILLIN ON THE "SLOWNESS" OF THE GAS COMPANIES OF NEW YORK CITY.—In the issue for June 4th of that publication known to fame as the New York *World*, Mr. Pulitzer's young men, and likely some of the old ones also, attacked the question "Is Gas too High?" the debatable ground for the question being New York city. Having introduced their compilation with the usual jumble of absurdities respecting the cost of gas in New York city, the young and old men set forth to interview those posted in the business as to what they thought about gas rates here. Among these oracles appears the name of Emerson McMillin, whose flow of opinion was free and easy. He displayed, however, a great amount of eccentricity in his compilation of the business of the Consolidated Gas Company, for instance. He thought the Company was sending out 8 thousand millions cubic feet per year, and "figured" that the gas cost the Company 85 cents per 1,000. Further, he was "fain to confess that they [the New York Companies] are a little slow." As a leading person in that absurdity known as the East River Gas Light Company, he ought to know how it is in that concern, which to a man up a tree does not by any means seem to be fast. However, he thought the East River Company would be glad of the chance to furnish gas in New York at $1 per 1,000, which remark leads to the query that Mr. McMillin, as President of the Laclede Company of St. Louis, is there countenancing the sale of gas at $1.18 per 1,000, and that he is comfortably resting there under a load of stocks and bonds, that if the like load were put pro rata on any Company in New York city, the holders of the common stock would never waste much time in depositing dividend checks. Slow, eh! Well, that is too bad. Still we imagine that when the time comes to show some degree of speed to the East River Company's backers—if that time ever approaches—the other New York Companies will be able to maintain the pace. Meanwhile, perhaps Mr. McMillin will have a chance to show the speed of the Laclede Company, in St. Louis, judging from the shape gas affairs are there assuming.

[OFFICIAL REPORT—REVISED BY THE SECRETARY—CONCLUDED FROM PAGE 818.]

SIXTEENTH ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

HELD AT KINSLEY'S, CHICAGO, MAY 17, 18 AND 19, 1893.

FIRST DAY—AFTERNOON SESSION.

Mr. H. D. Walbridge, of Grand Rapids, Mich., then read the following paper on

THE DUTY OF GAS COMPANIES TO THEIR CUSTOMERS.

Mr. President and Gentlemen of the Association:

As a rule, I think we do not approve of apologetic prefaces to papers read before us, but the subject the Executive Committee has assigned me is so broad and long and deep that in a short paper I shall hardly be expected to more than suggest some of the important obligations of gas companies to their customers; even this I undertake with diffidence and hesitation, well aware that I am addressing gentlemen much better informed, through experience, observation and study, than myself, and to whom I often go for information and advice.

Most manufacturers have the entire world for a territory, and rarely or never meet those who buy their goods; but the territory of the gas company is necessarily limited, and the relations between customer and producer are close. Upon the nature of these relations, whether cordial or the opposite, depends in a large degree the full success of the enterprise. In my opinion a simple definition of the duty of a gas company to its customers would be that duty which it owes to itself. Hence a company will best promote its own interests by giving every attention to the interest of its customers, and letting the customers know it, and, if possible, make them appreciate it. On this occasion, to better illustrate my remarks, I will organize a new company. It will be in some respects ideal, and I will tell, not how the company I represent is managed, nor how any other company I ever heard of is conducted, but in its management will be the good points observed in many. We will call it the Utopia—an excellent name for the promoters to use in a prospectus.

The Utopia will have a reasonable capitalization, a most vital point in the success of any enterprise, and especially so in the gas business. The manufacturing department will be well and economically managed, something we all recognize the importance of as one of the first duties to ourselves. With reasonable capitalization and a high grade, economically produced gas, with the resultant possible low price, based on consistent though possibly different rates for various quantities or uses, we have only to consider the relations of the Utopia to its customers. The first and one of the most important factors is the office; that department which comes most directly in contact with the public. In the office of the Utopia, placarded all over the walls, will be the legend, "We strive to please;" the head clerk or clerks will be affable, amiable and of pleasing address, and will be thoroughly informed upon every detail of the gas business. He will be able to answer all sorts of questions, and will have the tact and *time* to pacify and satisfy those who come with fire in their eye. Outside the office he will have the faculty of making friends and keeping them. The clerical force will, of course, be careful and intelligent, thereby insuring prompt and accurate information as to accounts, etc.

In the distributing and sales department of the Utopia will be cast iron rules governing the employees, which will insure prompt and efficient service to the customers, and in this department the legend "No trouble to show goods" will be written in letters of shining gold. The department will be in charge of a competent foreman or superintendent, who will be subordinate to the office. Meters will be set promptly, the same day, or even the same hour as ordered, if need be. Stoves and apparatus will be promptly set when ordered, the connections will be left gastight, and the customer will be fully instructed as to the operation of the apparatus. Meters will be cheerfully tested whenever the request is made, or when questions arise as to their accuracy, and without charge. Complaints of all kinds, no matter how seemingly trivial, will receive full consideration and prompt attention; defects will be remedied or removed when they exist, and the cause fully explained to the customer. Gas leaks of any nature, whether in company's mains and pipes or in the pipes and fixtures of the customer, will be promptly investigated and stopped without charge. Under no consideration will the Utopia allow any of its employees to empty or spill condensation from meters or drips either in the public street or alley, or around any private premises, causing dissatisfaction and disgust to a customer or to a prospective one. Poor lights and unsatisfactory service will be given

special attention and the causes removed. If the service pipes or meters are too small, they will be replaced with larger. If the internal piping is at fault the difficulty will be fully explained and a remedy suggested. If a fixture is stopped up, it will be taken down and cleaned. If the burners are poor, good burners will be provided. The Utopia will be determined to satisfy its customers and make them feel that an honest endeavor is being made to give them the best there is to be had. Good, ordinary lava tip burners are inexpensive, necessary to a good light, and will, of course, be put on free. When a customer, as they will sometimes do, complains of the size of his gas bill—well, gentlemen, that is a point upon which I have had some experience, yet I am to day as unable to offer any suggestions as when I entered upon my career, and the Utopia's method of dealing with this class of complaints I will leave to your imagination.

At the Utopia's office, or shop, will be a man from 6 P.M. to 6 A.M., competent to receive and record complaints *and attend to them;* in addition to this, he will attend fires that occur on the line of the company's mains, to save meters and property and prevent waste of gas. The company will be anxious to accommodate its customers night or day, and its aim will ever be to keep its customers satisfied. This company will not be satisfied to maintain an office with the service I have described and wait for customers to come in; it will send out and bring trade in; it will have an advertising department, and will conduct an educational campaign; it will have the right sort of literature to convince people that its gas is one of the best and greatest things on earth. This literature will be neatly printed, appropriately illustrated and readable. The pamphlet issued in 1892, by the Columbus (O.) Gas Company, is an admirable example of ideal gas advertising literature, and is one of the best things of the kind I have seen. The Houston (Tex.) Gas Light Company recently sent its customers a burner cleaner, with a neat card attached, instructing customers how to use it, and the card serves the double purpose of advertising the company and saving the cleaner from being lost. The London (Ontario) Company issued a pamphlet in 1890, descriptive of gas cooking stoves, which was original, and as an advertising medium first class. The Minneapolis Company issued a pamphlet somewhat similar in its scope, and other companies have done the same, presenting the advantages of gas in an attractive and readable form, and telling of the many uses to which it can be put. There can hardly be too much of this sort of stuff, and the Utopia will have lots of it. In this bureau of publicity will be a competent man, whose duty it will be to drum up trade; he will solicit orders for stoves and other apparatus, will visit builders of new houses and blocks to see that provision is made for use of gas, and then see that work is put in properly; for the company will have rules regulating all internal gas piping for both light and fuel purposes, *and will enforce them.* He will be an eloquent man and of agreeable manners, and will leave a favorable impression upon the people he meets. In the winter, when the stove business is quiet, he will be constantly employed visiting customers, to see that their service is satisfactory, and either reporting or personally remedying defects which he discovers, but which might not otherwise come to the company's notice. How many old iron fishtail burners with one opening completely stopped, and giving practically no light at all, do you suppose a man would find in a town of 50,000 population on his first tour around in the fall? What a general improvement in the condition of the gas lighting apparatus would follow his work. This man, on his visit, will make practical suggestions to the customers in the direction of improvement in their service. He will suggest a check or governor burner where gas is wasted through lack of them, and in various other ways will show that the customer's interest is near to the heart of the company. He will tell of improved appliances and hint at new and desirable apparatus, and will always assure the customer that he or she will be a welcome visitor at the office, where it will be "no trouble to show goods."

Even though the Utopia may not carry a stock of stoves, heaters and other apparatus, it will be fully informed as to the stove business done in the town, and will carry a full line of samples of apparatus in its office, and will be able to refer the customer to a reliable dealer from whom to buy. The Utopia will certainly carry and exhibit a full line of all the best and latest improved burners and gas light apparatus, together with the necessary glazed and experimental meters, photometer, etc., for exhibiting and explaining their efficiency, and it will probably have the stoves, heaters and other apparatus as well, all of which it will be prepared to deliver and place ready for use. The stove and apparatus branch of the business will be conducted on a liberal, broad-gauge system, "satisfaction guaranteed or no sale." Goods will be sold on contract and easy payments when necessary. The company will lose nothing on its sale of apparatus, but the profit will be reduced to a minimum. The Utopia will never antagonize another reputable dealer in gas appliances.

Following the policy I have outlined you can imagine the Utopia standing well in the community, its relations to its customers of a most friendly nature and its business steadily increasing. Its only enemy and most formidable obstacle will be ignorance, and the company dependent upon its size will feel justified in spending an amount equal to from 2 to 10 per cent. of its gross expenses each year in advertising gas and educating people how to use it properly. I venture to say that it is the experience of you all that more complaints and more dissatisfaction arise from ignorance than from any other source, and that money expended in education is well and profitably expended and will yield a rich dividend. Whether or not the Utopia will be a success from a dividend paying point of view I will leave for you to determine. The capitalization will be reasonable. In the mechanical department all the best appliances and methods will be found, and its relations to the public will, I think you will admit, be cordial and all that can be desired. The company in effect will be doing business on the same plan as the grocer and the dry goods merchant. Its business will be to sell gas and its motto will be "No trouble to show goods." It will treat its customers as the merchant treats those who deal with him; it will give satisfaction or know the reason why, and no trouble or expense will be too great to remedy defects in the service to its customers. It is largely to the increased consumption that we must look in the future for means to reduce prices on our product and increase our net profit. To increase consumption the company must first use every possible means to furnish a high grade of light and then educate and help its customers to use it to the best advantage. Literature and solicitors are good advertising mediums, but after all, the best, most profitable and the cheapest advertising that any company can obtain, is customers well satisfied with what they get and well pleased with the treatment given them.

Discussion.

The President—You have listened to a very interesting paper on the policy adopted and in practice by the Grand Rapids Gas Company. Please give it a full criticism. A paper of this character should not go out without something being said about it.

Mr. Somerville—I think Mr. Walbridge omitted to mention that the Utopia Gas Company ought to have a man with four hands and be capable of being in two places at once, as otherwise the Utopia office would be short of a man from 6 P. M. to 6 A. M., and they could not receive, record and attend to the complaints. I do not see very well how a man can attend to complaints and still be at the office. The idea, of course, is very good, but I think that the Utopia Company ought to be under the Board of Commissioners, so that while doing so well by the consumer some other company would not come in and turn the Utopia Company out. That would be my experience. The more we do, perhaps, the less thanks we get for it.

Mr. Odiorne—I would ask Mr. Walbridge what he does when a customer says that his bill is too high; that he has not used the amount of gas charged for, and that he would like a new meter. Do you give him a new meter?

Mr. Walbridge—Yes; right off—anything that he wants.

Mr. Butterworth—I think that Mr. Walbridge answers the question exactly right. I would give him a new meter and satisfy him.

Mr. Odiorne—You would have to give a good many new meters.

Mr. Walbridge—I would give him two if he wanted them.

Mr. Murdock—Ordinarily, one meter satisfies them.

Mr. Walbridge—In reply to what Mr. Somerville said I will say we have an arrangement with the Telephone Company by which any complaints received during business hours are made a note of in the telephone office; and when the man returns to the office he gets a memorandum and attends to it. We have no difficulty in promptly answering complaints, but if it is necessary to have four men for this work—or whatever number it is necessary to have to attend to it properly and promptly—have them.

Mr. Thompson—In any town where such an arrangement can be made with the Telephone Exchange the complaints could, no doubt, be covered by the Telephone Company; but what would you do if a complainant came to the office in person?

Mr. Walbridge—Have another man, if necessary.

Mr. Thompson—If the man is on duty from 12 o'clock, noon, until about 11 o'clock at night, the greater part of the complaints will be received during that time, which would practically leave all the district covered by any company without any one to complain to at the office, unless the complaints were sufficient to require the services of another man while the other was out.

Mr. Lansden—I believe in giving prompt attention to complaints. As a general thing gas companies, the larger they get, the more careless they are about individual complaints. We have never had such weather in Washington as we have had this year; and we found it necessary to establish a telephone service until 9 o'clock. The result has been that we have had as high as 10 men out attending to complaints at night. My idea is to educate the consumer.

Mr. Boardman—It seems to me the paper read by Mr. Walbridge is excellent as a suggestive paper, and that to go into the matter of details in all its departments is hardly fair to the writer. The paper sets forth the points towards which we must strive. None of us can hope absolutely to reach them all. The idea of the paper is that in the general conduct of the business we should strive to make it acceptable always to the consumer, strive to please the consumer in every reasonable request that he may make, and to educate him where he does not understand all the troubles that are coming up as we understand them. It is, as he says, because of ignorance that a great deal of the dissatisfaction expressed by our consumers arises. With patient explanation from an intelligent and affable official a great deal of trouble between the consumer and the company can be done away with, and a disgruntled consumer changed into a friend to the gas company. It is for that general plan as laid out in his sketch of Utopia that I think we are indebted very largely to Mr. Walbridge for presenting it in such a form; and it is to the importance of striving to reach this perfection that he outlines in his imaginary company that we wish to call the particular attention of many of our younger gas managers. I move a hearty vote of thanks to Mr. Walbridge for the paper which he has so kindly given us. (Carried.)

The President—We will next listen to the paper, by Mr. O. O. Thwing, of St. Louis, on

GAS ANALYSIS.

In Winkler's "Handbook of Technical Gas Analysis," the author makes the following statement: "In order to arrive at results which satisfy practical requirements, without laying claim to the utmost attainable degree of accuracy, technical gas analysis must first and foremost aim at working by the simplest possible means and with the least possible waste of time * * * Analytical results, which the manager of the works can only receive from the chemist after the lapse of days or weeks, are in most cases entirely useless to him, let them be ever so accurate." All "gas men" will undoubtedly endorse the distinguished author's statement, and will also agree that there is another qualification which might be made—that of cheapness. In the hundreds of small works scattered over the country there are superintendents to whom a knowledge of the constituents of their gas, especially the impurities, would be of great benefit, but who do not feel justified in purchasing an expensive outfit for the purpose of analysis, or perhaps doubt their ability to use one if they possessed it.

It is the object of this paper to describe an instrument, which, in simplicity and accuracy, will compare favorably with any apparatus designed for the analysis of gas by absorption. It can be used intelligently by any one who can compute percentage, and a ten-dollar bill will cover the expense of a laboratory which will be a surprise and delight to its possessor.

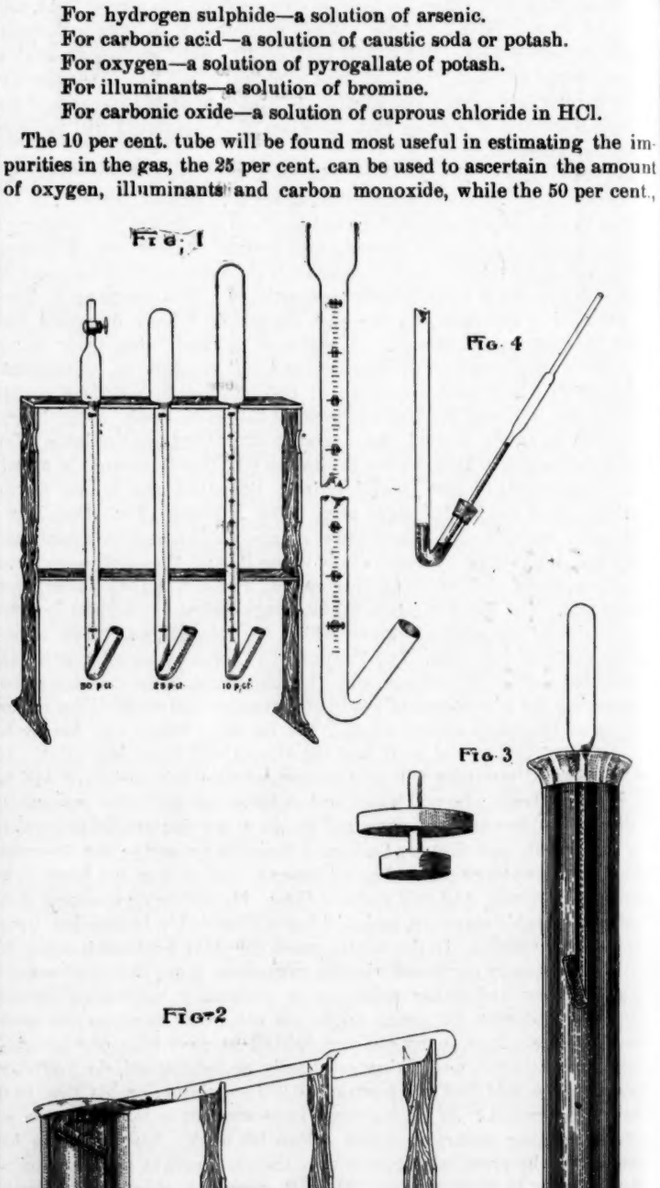
This instrument is called the Cooper's Tube or Eudiometer, and was first made for and used by Mr. Lewis Thompson, of England. It seems not to have met with much favor from the start, and very little mention of it will be found in any of the technical books. About the year 1888, Mr. B. E. Chollar, then of Topeka, Kansas, realizing the desirability of a cheap and simple means of gas analysis, and believing that there were possibilities in the Cooper's tube which had been overlooked, designed it in its present form. Since that time it has been in almost constant use in works under his management, and has more than met the expectations entertained of it at the beginning.

It consists of a glass tube, enlarged to a bulb at the closed end, and bent about 2½ inches from the open end, so that the short leg forms an angle of 45° with the tube. Three sizes, called respectively 10 per cent., 25 per cent. and 50 per cent. tubes, will be found sufficient for gas analysis. The 10 per cent. tube shown here is 22½ inches in length, and its volume to the 1,000 mark on the leg is 200 cc. This volume is divided into 1,000 parts, of which 100 parts, or 10 per cent., is contained in the graduated portion of the leg. This is graduated into 100 divisions, beginning at 900 near the bulb and ending at 1,000 near the bend. Each division, therefore, of the leg indicates one part in 1,000, or one-tenth of one per cent. of the whole volume. The 25 per cent. tube contains one-quarter and the 50 per cent. one-half of the entire volume in the graduated leg, and they are graduated respectively into two and five parts per 1,000. (Fig. 1.)

In addition to the eudiometers there will be required a few glass beakers, a glass cylinder or equalizer, about 24 inches high, to contain water in which the tubes can be completely submerged, a rack to hold one or more of the tubes in an upright position, bulb uppermost, a stand on which the tube can be inclined with its mouth in a beaker of water to allow the saturated absorbents to run out, a 10 or 20 cc. pipette and some flexible rubber tubing about $\frac{3}{16}$ inch bore. The absorbents should be as follows:

For hydrogen sulphide—a solution of arsenic.
For carbonic acid—a solution of caustic soda or potash.
For oxygen—a solution of pyrogallate of potash.
For illuminants—a solution of bromine.
For carbonic oxide—a solution of cuprous chloride in HCl.

The 10 per cent. tube will be found most useful in estimating the impurities in the gas, the 25 per cent. can be used to ascertain the amount of oxygen, illuminants and carbon monoxide, while the 50 per cent., with glass stop-cock at end of bulb, may be used as a gas burette to estimate hydrogen and methane by combustion.



In starting to test foul gas for impurities, first fill a beaker and the equalizing cylinder with water that has been standing in the room long enough to acquire the temperature of the surrounding air. This water should be clear, but not necessarily distilled. Take a 10 per cent. tube and with a piece of rubber tubing make a connection at any convenient point on the foul main. If the connection is made to uncondensed gas, it is well to interpose a tube filled with waste or some fibrous material to extract the tar which would dirty the eudiometer. After connecting the rubber tube allow the gas to blow through it for a few seconds, and then push it into the eudiometer past the bend and up into the bulb. If the tubing is wet this can be done very easily. Allow the gas to blow for two minutes, or until it has displaced all the air, and then slowly withdraw the rubber tubing (allowing the gas to blow meanwhile), and quickly close the mouth of the eudiometer with the thumb or a rubber stopper as the tubing emerges. Place the foot of the tube in the beaker of water, and allow water to enter and seal off the gas at the bend. Immerse the

tube in the equalizer and hold it in place beneath the water by means of a weighted cover until all contraction or expansion has ceased, which will usually occur in a minute or so. Then raise up the tube as quickly as possible, and when the levels of the water inside and outside of the tube coincide, read the volume of the enclosed gas as indicated by the graduations on the tube. By this means the volume is determined at a constant pressure and temperature. If the gas should be cooler than the water at the start, it will probably expand so that a reading cannot be taken. In that case take the tube out of the equalizer and carefully allow enough gas to escape to allow a reading to be made. (Fig. 3.)

After noting the volume of the gas, place the tube in the rack and with the pipette draw the water from the short leg (Fig. 4), being careful not to break the seal at the bend, which would allow air to enter and mix with the gas. Fill the space left in the short leg with the arsenic solution, close the mouth of the tube with the thumb or rubber stopper, being careful not to enclose any air in doing so, allow the solution to run into the bulb and shake thoroughly to bring the solution in contact with the enclosed gas. After two or three minutes shaking run the liquid to the bend and into the short leg, expelling all the gas back into the long leg and bulb. Be very careful that no gas remains in the short leg. Immerse the mouth of the tube in the beaker of water and remove the thumb or stopper. The gas will contract and more or less water, according to the amount of H_2S there was in the gas, will rush into the tube. Lay the tube on the stand, with its mouth sealed in the beaker of water, in such a position that the solution by its greater gravity will run out and clean water take its place (Fig. 2). When this has been accomplished immerse the tube in the equalizer, and when the gas has ceased to expand or contract, read the indicated volume as before. The difference between the first and second readings indicates the proportion by volume of H_2S there was in the foul gas.

Take the tube with the gas remaining in it, which is now free from H_2S, and repeat the preceding operation, only using the caustic potash or soda solution in place of the arsenic. The difference between the second and third readings indicates the proportion of CO_2.

Suppose the results to have been as follows:

First reading—original volume.....	1,003
Second reading—after As_2O_3.....	984
Third reading—after KOH.....	972

We therefore have found in the original 1,003 parts of gas, 19 parts of H_2S and 12 parts of CO_2, which is equivalent to 1.9 per cent. H_2S and 1.2 per cent. CO_2. If the operator should prefer to compute the percentage it would give 1 894 per cent. H_2S and 1.196 per cent. CO_2, which looks very scientific and amounts to nothing.

The determination of impurities in the gas, as given above, will be of the most practical value and interest to the gas manager, but if he wishes to delve deeper into its mysteries, let him take the proper eudiometer and extract the following constituents in the order given:

1st. Sulphureted hydrogen.

2d. Carbonic acid.

3d. Illuminants, by bromine solution. This absorbent should be shaken with the gas for from 5 to 8 minutes. An expansion will probably occur after this operation, caused by bromine fumes liberated in the tube. These can be absorbed by treating the gas with the potash solution after the bromine solution has been removed. The reading must not be taken until this is done.

4th. Oxygen, by means of pyrogallate of potash. Two or three minutes shaking will suffice for this operation.

5th. Carbonic oxide, by cuprous chloride solution. This will require 8 or 10 minutes shaking, and even then not all of the CO will be absorbed. The absorption of CO by cuprous chloride is purely mechanical and never perfect. About 5 per cent. of the CO will remain and may be added to the amount indicated by contraction. Thus if the analysis shows 20 per cent. CO, the corrected amount would be 21 per cent. It is well to use the potash solution again after this operation to absorb any hydrochloric acid gas which may have been liberated. In using the potash for this purpose, be careful to allow all the cuprous chloride to run out of the tube before introducing the potash, as otherwise the CO will be released from its absorbent.

It is almost unnecessary to say that the eudiometers and beakers should be carefully washed after each analysis. The water in the equalizer can be used for several experiments if care is taken to thoroughly remove the solutions from the tubes before immersing them.

The use of the eudiometer for the analysis of hydrogen and methane by combustion requires considerable additional apparatus and some degree of experience and skill in manipulation. It cannot be described in this article, but those who are familiar with other apparatus will readily see how easily it can be accomplished with this one.

APPENDIX.

1. *Beakers and Pipettes.*—Griffin's lipped beakers No. 5 or 6, holding ½ pint to 22 ounces, will be found most satisfactory with this apparatus. Ordinary volume pipettes of 10 to 20 cc. capacity will answer all purposes. A small cork can be bored and slipped over the end to prevent the pipette from entering the leg of the tube too far.

2. *Solutions.*—It is well to buy chemically pure reagents, as the difference in cost is trifling, and enough for an extended series of experiments can be bought for two or three dollars.

To make the arsenic solution, put about a teaspoonful of arsenic in a pint of distilled water and keep it near the boiling point for an hour or two. Arsenic is almost insoluble in cold water, but by this means a strong clear solution can be obtained.

Caustic potash or caustic soda is obtained fused in sticks and a moderately strong solution can be used, as experience suggests. The writer prefers to cut off a small piece as large as a pea from the end of the stick and allow it to dissolve in the tube.

Pyrogallic acid is in the form of a white powder, which is extremely soluble in water. Only a little of this should be made up at a time. Dissolve a teaspoonful in a six ounce bottle of distilled water, and it will suffice for many experiments. Add the KOH to the solution after it has been poured into the eudiometer.

Bromine should be diluted with several times its volume of water. Great care should be taken not to inhale any of its fumes.

To make the cuprous chloride solution dissolve an excess of the white of monochloride of copper in hydrochloric acid. The excess will sink to the bottom of the bottle. A few pieces of metallic copper should also be added to the solution.

Discussion.

The President—You have heard a paper showing us how every man can be his own chemist. Mr. Thwing will now, as far as he is able, perform a few experiments. These jars are all filled with coal gas—it is St. Louis gas, and I hope Mr. Thwing will not find it too bad.

Mr. Thwing—This is unpurified gas—taken from before the washer. While on this subject I will say that any of you who have a Standard scrubber, or any means of saving ammoniacal liquor, you will find that the ammoniacal liquor will take out about 30 per cent. of sulphureted hydrogen from the gas. That is, you will find more sulphureted hydrogen before your scrubber than you will after it; or, in other words, the ammonia liquor acts in taking out sulphureted hydrogen from the gas. The first step in this analysis is to uncork the tube under water, which must be done in order to prevent any gas from escaping.

Mr. D. McDonald—I would like to ask where that whole outfit can be bought?

Mr. Thwing—If the Association has no objection I will tell members where it can be bought, but I did not understand that that was allowed in the Association. Mr. Greiner, of William street, New York, furnishes these tubes to us. They are made to order, and he is the only person in the United States that I know of who can furnish them. The water has now sealed off the gas. There is nothing but gas in that tube now. Now it is placed in the equalizing chamber in order to equalize the temperature. The water, of course, during several experiments, will not change its temperature at all, especially if it has been kept in the room for some time before. The water should be as near the temperature of the room as possible, and it should be allowed to stand in the jar for some time before the experiments are made. A part of this water is warmer and a part is colder than the air. Now that the gas has come to a standstill, I remove it. That reads 999. There are, therefore, 999 volumes of gas, or the gas in the tube is divided into 999 parts. If you will refer to the paper you will see there should be a rack whereon to set the tube, in order to introduce the pipette. This is the arsenic solution, or arsenious acid. It is common commercial arsenic. This pipette is used for extracting the liquid from the short leg. That cork is placed there so that the end of the pipette will not reach below the bend, and not allow the air to enter into the long leg and bulb. Now the arsenic solution has been placed in the short leg. I have corked it up under water so as to allow no air to enter. Now it will run down into the bulb. That purifies the gas the same as an oxide purifier does; that is, it takes out the sulphureted hydrogen. Anyone who experiments with this apparatus will notice that if the gas is taken before the ammonia is extracted it will not stain the solution at all, it will be reasonably clear; but if it is taken after the ammonia is taken out then the solution in the bulb will turn quite yellow. Now the water level should rise in the tube when the cork is taken out. You notice that it does rise to an appreciable extent. There should be a stand here to rest the eudiometer on, so that the solution will run out. You will see that the greater specific gravity of the arsenic solution caused it to run out of the tube and the

clean water takes its place. The solution should be allowed to run a little longer, but as the time is short we will let it go at that. Now the tube is placed in the equalizing chamber again so as to cause the temperature of the gas in the eudiometer to correspond with that of the original reading. The present reading is 987; the former reading was 999. That makes 1.2 per cent. of sulphureted hydrogen in the gas. The next step is to take out the carbonic acid with caustic potash or caustic soda. This is caustic potash that I have here. The amount of ammonia in the gas is so small that, although it could be determined by using sulphuric acid, it would not amount to much—volumetrically it would be very small. This caustic had better be handled with tongs, as it has a destructive effect on the skin. It can be handled several times, but in the end it will cause trouble. It dissolves in water very quickly and takes out the carbonic acid in the gas. Now the piece of caustic potash that I placed in there has completely dissolved. Its action on carbonic acid is very quick, and by the time it has dissolved it has taken up all the carbonic acid in the gas.

Mr. Lansden—What is the reaction?

Mr. Thwing—It forms carbonate of potash. Now you will see that the heavier liquid is running out of the bottom, and lighter liquid is taking its place in the tube. After each operation the gas must be equalized, of course, in pressure and temperature. The reading of the leg this time is 977, showing 1 per cent. of carbonic acid. I think that these percentages obtained to-day are a little less than they should be. The gas was simply taken into tubes and stopped with rubber stoppers, and I have found by experiment that this system of sealing will not confine the gas altogether. That is, if you inclose a sample of foul gas in a tube sealed with a rubber stopper, leaving it so remain for several days, you will find its percentages of impurities will be much smaller than if you analyze it directly. In order to keep a sample for some time you should seal the mouth of the tube thoroughly. I think that rubber absorbs some of the impurities. The next step will be to take out some of the illuminants by means of a solution of bromine. I have not filled any of the smaller percentage tubes with gas, and so I will have to go as far with the 10 per cent. tube as I can. You will notice how the bromine fumes fill the tube. The water has absorbed nearly all the bromine in this case, as the water was a little alkaline. The reading, after using the bromine solution, is 933. That taken from 977 leaves 4.04 per cent. of illuminants. After the bromine solution the pyrogallate of potash solution should be used. I will skip that. After the pyrogallic acid solution for testing for oxygen is used, the cuprous chloride solution should be used in testing for carbonic oxide. That will extract the carbonic oxide from the gas. This must now be shaken up for a considerable time in order to absorb as much as possible of carbonic oxide. I think that will be sufficient to show the action of the cuprous chloride solution in testing for carbonic oxide. Of course it has now to be equalized and read again. In this connection I wish to draw special attention to the fact that the absorption of carbonic oxide by the cuprous chloride solution is purely mechanical, and not at all chemical. In using the potash solution after the cuprous chloride solution be careful to let the tube stand long enough to allow all the cuprous chloride solution to run out before inserting the potash. It has been suggested that I should show you how to allow some of the gas to escape when the reading is too far down the tube; that is, if the gas is cooler than the water in which you immerse it to equalize the temperature it will expand, and occasionally it will come clear down to the bend. Then, of course, you cannot read the volume of the gas at all. Suppose it was in that position, place it in the beaker, place the thumb over it in that way, and allow a little of the gas to run into the short leg. Then place it down in the beaker and remove the thumb until you have allowed enough gas to escape to enable you to make the reading on the long leg without allowing any air to mix with it. Now I will show the method of testing the air for oxygen. In washing these tubes out we should have a connection with the hydrant, or with water pressure, slip a small rubber tube into the eudiometer and allow the water to rush in and wash it out thoroughly. If you have no water pressure you can take a beaker, pour water, holding it in position so that the water will run down the short leg and then down the long leg into the bulb. This tube is now supposed to be filled with air. Twenty five per cent. of the volume enclosed is in the leg of the tube. This is a solution of pyrogallic acid. This is the pyrogallic acid as it can be bought. It is simply a white powder. You can absorb a large quantity of it in a small amount of water. The reading on this 25 per cent. tube is 1,004. It is best to put in the pyrogallic acid first and the potash afterwards, because if the two together are allowed to unite they will absorb the oxygen from the air. This is caustic potash that I am now putting in with the solution of pyrogallic acid. You notice that that is turning a very dark color as soon as it combines with the oxygen. In tests for oxygen in air with these absorbents I have always found 20.6 per cent. I believe that the books give 20.7 or thereabouts. That will show the method of taking oxygen out of any gas sufficiently to test it.

Mr. D. McDonald—Can marsh gas be determined in that simple way?

Mr. Thwing—No; determining marsh gas is quite a complex process. Marsh gas has to be burned into carbonic acid, which is absorbed by an alkali, and then titrated with oxalic acid. The method of determining marsh gas is to burn it over oxide of copper in a porcelain tube. It has no absorbent at all. That is the purpose for which this 50 per cent. tube with a glass stopper was designed. The gas can be driven from these tubes through a porcelain tube and then burned over that into carbonic acid and absorbed further on.

Mr. Miller—You can approximately get it by explosion?

Mr. Thwing—Yes; it is about the same thing. If extreme accuracy is desired in taking a sample of gas it would be well to fill the eudiometer with water; but I have found that for ordinary gas analysis it is just as well to displace the air with the gas as it is to fill the tube with water. Of course, if you fill the tube with water to the top, and then hold it in that position, the water will remain in the tube, and then you can make your connection to any gas supply, and by running the tube beyond the bend and up into the bulb, you can displace the gas with water and be absolutely sure that there is no air in it. I made several experiments in that manner and found that the results coincide, whether you displace water with gas or displace air with gas. The way of filling the tube is to make your connection, of course, to any part of the works you wish to get the gas from; insert the rubber tube in the eudiometer and let it run up in the bulb, and allow the gas to flow for a few moments, and then, when you are satisfied that the gas is displaced here, slowly withdraw the tube. It is well to watch the mouth of the tube to see that the gas is flowing, because sometimes there will be a kink or a stoppage in the tube which will prevent the gas from flowing. So you need to watch it closely. Then, by slowly withdrawing the tube in this manner, you can be satisfied that the gas has displaced all the air in the eudiometer. When the tube is ready to be withdrawn I simply pull it out in this way. It can be closed by simply holding the thumb there, and as the rubber tube comes out slip the thumb over the opening.

The President—If any member wishes to ask Mr. Thwing any questions there is now an opportunity.

Mr. Woodward—How long does it take in practice to make that analysis by making those five absorptions?

Mr. Thwing—It would probably take three quarters of an hour to go through the whole thing. And, by the way, I will say that in testing gas it is a very nice way to take three tubes and fill them all at about the same time. Then you can have one tube equalizing, another tube emptying into the beaker, and in the remaining one you can be shaking the absorbent. In that way you can have three operations following one another, and thus you make three analyses in almost the same time required to make one.

Mr. Bredel—I would like to make a few suggestions about how to prepare the solutions. Also about the water used in the beaker and in the equalizer. I think it would be a good plan to use purified gas and saturate the water completely with the gas, so as to absorb all the illuminants that the water will absorb at any time. Then make your potash solution as strong as possible (say, about 1.26 specific gravity), and you will have no danger of absorbing the illuminants with the water. That is to say, make all the solutions out of distilled water that is completely saturated with gas.

Mr. Thwing—I would say in that connection that the absorption of illuminants by water would be very small anyway. In fact, any gas analysis in which water is used as the sealing fluid, and in which solutions are used in this way, cannot be absolutely correct. The only way in which they can be made correct is by using the bunsen tube and a mercury seal. You cannot expect to be absolutely correct with this plan.

Mr. Bredel—That would be so for water gas. Coal gas, not containing so many illuminants, the illuminants are not so readily absorbed by water as are the illuminants of water gas. Therefore, in water gas it is practically absolutely necessary to saturate the water in the beaker and equalizer, and of your solution, with purified gas. That can be very easily done, and without much trouble. Another thing. The monochloride solution, as we all know, is very difficult to get pure. It will decompose into chloride very rapidly and become greenish. I have found that if I boil this with metallic copper for any length of time, say for three or four hours, and then close it hermetically, the solution will keep for a long time and be absolutely clear; and then, the absorption is about three times as fast, and is a great deal more accurate.

Mr. Thwing—I have used a solution that has been kept for three

years that had a little metallic copper in it, but the solution showed no sign of greenish tinge.

Mr. Bredel—Did you boil it?

Mr. Thwing—No; the solution was not boiled at all.

Mr. Bredel—I found that if I did not boil the solution it would take three times as long to absorb it.

Mr. Thwing—The absorption by the cuprous chloride solution is simply mechanical. It relieves the tension of the carbon monoxide. You cannot thoroughly clear it from the gas by the cuprous chloride solution.

Mr. Bredel—I found that in a gas containing from 20 to 30 per cent. of carbonic oxide it would all be absorbed by changing the gas 15 or 20 times; but with another part of the solution it would take 50 or 60 times. That is the difference.

Mr. Thwing—I have never had that experience. In most tests the same solution is used successively for condensing or absorbing the constituents of gas, but in this case a fresh solution is put in in every case, and a fresh solution acts much more quickly than a solution which has been in use for some time. In the Hempel apparatus the solution is used over and over again, and if you put clean gas in a Hempel apparatus, which has been used for taking out carbonic oxide, you will find carbonic oxide in the gas even when there was none there before. I may say that in making the test we use a very large excess of cuprous chloride.

The President—What these gentlemen have been talking about we practical gas men will very seldom have anything to do with, and these tests may seem to some of us difficult and mysterious. Gas men want to test for carbonic acid frequently, but they will not need to make these other determinations perhaps oftener than once in three or four years. Most of these analysis can be made in 10 or 15 minutes. Are there any further remarks?

Mr. Jenkins—I think that this has been a very interesting paper. The subject has been so treated that we, especially in small works, have had matters brought to us now that we have never been able to handle satisfactorily before. I move a hearty vote of thanks to Mr. Thwing for his paper, and for his experiments. (Carried.)

The President—Next in order will be the reading of a paper, by Mr. J. R. Smedberg, of Chicago, entitled

WOOD GAS DURING THE WAR.

During the year 1854 a German named Breisach submitted a wood gas apparatus to the consideration of the trustees of the Philadelphia gas works, by whose authority it was put in operation and kept at work for a sufficient time to ascertain that it was capable of yielding a very good product from different varieties of wood, but was subject to certain derangements of parts, which it was desirable to avoid, if possible. Cresson's cellular retort was accordingly devised, in which the gas generated in a ⏛ shaped chamber, traversed several longitudinal passages under its flat bottom before reaching the stand-pipe. It was stated, as matter of official record, "that by the use of this improved appliance one cord of ordinary firewood of any of the commercial varieties yielded nearly twice the volume of gas obtained from a ton of the best Pittsburgh coal, the candle power being the same in either case."

The following values were obtained, viz.:

One cord of ordinary pine, equal to 800 lbs. sperm.
One cord of oak or maple, equal to 900 lbs. sperm.
One cord carefully dried and split, equal to 1,300 lbs. sperm.

The illuminating power was about 25 candles for 4½ feet consumption, or say 5½ candles for each foot per hour.

The report for 1856 confirmed the previous statements as to the quantity and quality of gas obtained from wood.

The cost of making wood gas was stated as somewhat lower than that from coal, but the difference was not sufficient to justify the abandonment of the latter.

At the close of the year 1857, 30,000,000 cubic feet of wood gas in all had been made; the quantity of wood carbonized during that year alone being 1,717 cords. After this lengthened experience in the use of the cellular retort, it was no longer considered an experiment; the profits arising from it were stated to have more than repaid its cost twice over, and the important commercial advantages (in affecting coal contracts) contingent upon its possession were considered such as to make its continuance a measure of wise policy.

In spite of these favorable statements, which are quoted almost verbatim from the official reports, the wood gas manufacture obtained no permanent foothold in Philadelphia, or any of our middle or northern States.

Previous to 1861, these chambered retorts had been introduced in some of the southern cities, though the German practice tended to the use of large ⏛ retorts, such as were adopted in Savannah. We charged 1,000 pounds of wood per day per retort, employing 1½-hour charges; the yield per pound carbonized being 10 cubic feet of 18 to 20 candle gas, using iron retorts, as a matter of course.

One of the greatest difficulties connected with the necessary change from coal gas to wood gas was that of labor to cut the wood. All labor was rigidly controlled by the military authorities, and it was only after great trouble that a detail of 50 negroes and a white manager was obtained. Similar trouble occurred in securing railroad transportation, but this also was finally provided, and the supply of material thereafter was regular and certain. How different the southern light wood was from the pines, oaks or maples of the north will presently appear.

It was a common practice with Southern planters to girdle the pine trees as the readiest means of securing the cultivation of their estates. The leaves and branches soon fell off and an almost immediate return was derived from the soil without the delay and expense of felling and burning the forest growth; for in many cases the naked trunks stood for many years, the sap drying out, the outer fiber rotting off, and the resin consolidating in the heart. The short leaved, or "loblolly" pine undergoes no such change, in degree at least, owing probably to the much higher percentage of fibrous matter in its structure, and is, with the numerous deciduous trees, comparatively worthless as a gas producer.

It was to the long-leaved, or maritime pine that the seaboard gas companies of the South had to look during the war for compensation for their exclusion from the coal markets of England and the North; and the keen spur of necessity soon developed elements of wealth in the forests about them. The long-leaved pine, of which the "loblolly" is the second growth, is the most abundant tree from Norfolk to Galveston for a hundred miles from the coast; its supremacy as a tree of the "forests primeval" being disputed in the swamps and brakes and jungles by other growths.

These vast original forests, girdled and standing for years as mentioned, become converted into what is known in the South as "lightwood." It varies much in quality with the size of the tree and the character of the soil, and is a very poor gas maker where the trees have been tapped again and again for resin, as in Southeastern North Carolina.

A cord of first-class lightwood weighs 3,550 lbs., taking cutters' measure, which never holds out in re-cording, especially after a railway transit of 50 miles or over. Its weight is sometimes such that it will sink like a stone in water, though this seldom occurs except in the case of the knots, in parts of which not a trace of fibrous structure is discernible. These knots are nearly indestructible, and were sometimes used to form the step or "ink" on which works the main upright shaft of plantation horse powers, or for bearings in cotton gins. The average gas yield is 10 feet to the pound, the extremes being 8 and 15.

Remembering how rich the maritime pine is in resin, it would seem that the long continued action of the hot sun, joined in some areas to the occasional fires which attack the trunks without destroying them, drives in and accumulates the resin toward the center, while the outer annuli of fiber scale off or rot off under the action of these exterior causes. This gradual process finally gathers almost all the original gum of the trees in the heart, where the original moisture is displaced; until either the remaining fiber is embalmed in resin and thus preserved from further decay, or the trunk itself falls before the axe or the hurricane.

It is true that the quality of lightwood varies greatly in a field, all the trees of which have been girdled at the same time, but there can be little doubt that a very large and nearly uniform percentage of the original resin remains in each individual tree. Lightwood, then, is not a normal wood, as it contains a mass of the very richest hydrocarbons, with some varying but reduced proportion of fiber to act as dispersing material, and thus exercise an important function in fitting them for the uses of the gas maker.

In spite of the comparatively small amount of water held in lightwood, it was found necessary to shield it as carefully as possible from rain in order to obtain from it the highest yield and the best quality of gas. More than this, it rapidly deteriorates if split a long time before charging the retorts, even though under cover all the time.

It could not be advantageously used in the large shapes received from the cutter, any more than large lumps of coal, on account of the same difficulty of carbonization. Now it is known that the gas coals which yield the greatest volumes require the highest heats for thorough carbonization, a fact due to the greater amount of heat absorbed by the greater volume of their product; and in the same way, as a matter of both inference and fact, even the very driest woods drag down the heats very rapidly. It was found that an addition of only 7 per cent. of the

weight of the most advantageous charge would in 12 hours run down the heats so completely as to render them unfit for work.

It required close watching for many weeks to settle the point that 375 lbs. charged every hour and a half in two benches of threes (or 62½ lbs. per retort) gave the best results; and this allowance, after being once established, was kept uniform during the 3½ years of operation. When the amount sent out was to be reduced, charges were omitted entirely, but the weight per retort per charge was never varied.

But it was also found that when the wood was split too fine, the product went off in a puff up the stand pipe mainly as condensable vapor—the rapidity of evolution affording insufficient time for conversion into true or fixed gases against the hot interior surfaces of the retort. Strangely enough, it took us longer to ascertain and correct this tendency than to counter any other unfavorable peculiarity of this substituted method. Sticks of about 16 square inches in cross sections gave us the best results—anything larger being too difficult to work off, and smaller ones giving us a reduced yield of gas with more tar. Accordingly this size was preserved in splitting—the little charges being, as a matter of course, thrown well to the back of the retort, the settings of which were arranged to throw the heat well to the front.

For every cord of wood carbonized another cord was used for firing, the same wood being used for both purposes, except that the best sticks were reserved to go into the retorts. Occasionally a whole train load would be set aside for either gas making or fuel, on account of its uniformity of richness or poverty in resin.

Even in Georgia, the best quality of lightwood was not easily procured upon the seaboard, and every effort was made to use common pine in the fires; but the conclusion was that the lightwood was much cheaper in the end, in spite of its greater original first cost. The gas companies in Augusta, Charleston and Wilmington differed from us, however, on this point—perhaps on account of some difference in the respective prices paid for the different classes of wood.

It required 7 minutes to draw and charge the 6 retorts, and yet the make from 375 pounds of wood during the first half hour from the slackening of the lids was 2,200 cubic feet, during the second, 1,000 cubic feet, and during the third, 550 cubic feet. The stand pipes were only 4 inches and the hydraulic main 13 inches in diameter, but we managed to keep everything going without much trouble, and never had a stoppage between the hydraulic main and the consumers' burners.

For some time we put faith in the statement that low heats were to be preferred, and were accordingly annoyed by the stoppage of stand pipes every eight or ten hours, a low yield of poor gas, the frequent flooding of drips at the gas holders and in the streets, and a very heavy item of gas unaccounted for. All these disappeared as we improved the settings and the methods of firing and charging, until the process became actually superior, so far as the comfort of its operatives and general economy were concerned, to the coal gas manufacture.

We had, fortunately, the means of ascertaining the candle power with some accuracy, and found it to range from 16 to 22 candles, according to the condition of our lime supply. In turning on a box of clean lime the yield fell off at once from 14 to 16 per cent. Every effort was made to keep down the high percentage of carbonic acid, but the sinuous channel ways of the Savannah river delta, from which we had previously secured ample supplies of oyster shells were blocked by torpedoes, gunboats, monitors and picket barges; and stone lime could not be transported from the distant quarries of northwestern Georgia, Alabama and Tennessee. The lightwood gas, however, required far less lime than the wood gas made in the Philadelphia works, and we managed to get a scanty supply of shells. During the last two years of the war we used a bushel of lime to 12,000 cubic feet, and the gas gave very good satisfaction.

The gas holders gave two tenths of an inch more pressure than when storing coal gas, and the street loss rose from 7 per cent. with coal gas to nearly 14 per cent. with that from wood, calculated upon the volume sent out. It so happened that two temporary discontinuances of the public lighting enabled us to make this comparison very accurately.

We saved and sold the tar and charcoal, but the wood vinegar ran to waste, a constant flow of water being passed through the hydraulic main.

King's Treatise speaks of the curious habit of resin gas, especially noticeable when used to enrich other gas of lower illuminating power containing alkaline hydrates, of forming a viscid deposit on the interior surfaces of pipes and fittings through which the mixed gases are passed. This is produced by the combination of the resin vapor with the alkaline hydrates to form a peculiar buttery compound, which again has the power of absorbing from the gas with which it is in contact many times its own bulk of gaseous hydrocarbides upon which the illuminating character of gas depends. Hence the disappointment which has always followed attempts to use resin gas as an enricher in permanent working.

No symptom of the sort, however, occurred in our Savannah experience with lightwood gas. Our meters were wet, excepting that perhaps 150 of them were dry meters of Croll & Glover's make, and the burners were metal tipped of which the fishtail orifices were roughly enlarged by boring out, and the batswings with a saw; yet we had absolutely no deposit thrown down in our mains, services and fittings, no noticeable stoppage or obstruction of consumers' meters, and no clogging of the burner openings.

An effort was made some five or six years ago by a Cuban engineer, named, I think, Toraya, to introduce wood gas in a general way, and a small, private plant was erected in Philadelphia to show the beauty of the product and the value of his various devices. The unlimited supplies of cheap bituminous coal petroleum and naphtha made the venture, of course, a losing one, and it is not likely that wood gas will ever occupy any important place in our industry.

The officials of the Virginia City, Nevada, gas works were at one time desirious of lighting the adjoining town of Gold Hill, which was situated at a level 300 or 400 feet lower than the works, but expected that an exhauster, and perhaps a new distributing holder, would be necessary, and they hesitated for some months on account of the expense of the undertaking. At last they took outside advice and laid an extension of the Virginia City street mains down hill to the new district, actually getting more pressure throughout the latter, without any auxiliary appliance whatever, than they wanted. They were using the pitch pine of the Sierra Nevada, with enough of the splendid Hartley shale from Australia in addition, to keep up a tolerable illuminating value in the absence of lime purification. It is the only instance, probably, in which carbonic acid has practically displaced the exhauster and given an illuminating gas that travels as well down hill as up.

It was 1799 that Lebon began his experiments with wood gas, and his negotiations with Winsor based upon an exhibition in Paris in 1802 really induced the independent and laborious work of the latter, which in turn led to the formation of the Chartered Oas Company in London during the year 1804. Passing by the question of priority as between Murdoch and Lebon, in the development of gas lighting, it may be stated that the wood gas of the latter was made at so low a heat as to be mainly carbonic acid, carbonic oxide and light carbureted hydrogen, the useful tars running off to waste. Pettenkofer, about the year 1848, passed the primary product from a retort worked at low temperature through a range of red-hot pipes, and may be considered the father of wood gas as a practical process. Reissig shows a quadrangular retort with decomposing cells above and below the chamber which receives the charge of wood.

Next came the substitution of large converting retorts worked at high heats instead of Pettenkofer's restricted pipes, in connection with the retorts of carbonization, and lastly came the use of a dry room in which most of the natural moisture of the wood was removed before charging the retorts—these last being highly heated, lightly charged, and so increased in size as to afford large interior converting surface.

Pettenkoffer also proposed the passage of the gas from one charge of wood over the residuary incandescent charcoal of the preceding one, so as to reduce the carbonic acid to carbonic oxide. A modification of this method was employed by Professor Wilkinson in the works of the Mutual Gas Light Co., of New York city, through retorts being employed, and the charcoal of each charge being successively pushed back toward the stand pipe to make room for the wood of the next one. Over 50,000 cubic feet of a non illuminating gas was thus obtained from a cord of common pine weighing 3,300 lbs., the carbonic acid being cut down from 25 or 30 per cent. to about 10 per cent.

The conditions of coal supply as compared with that of wood induced an extended use of wood gas in Russia, Switzerland and Germany; its use in the latter country being so largely due to the many improvements of Mr. L. A. Reidinger that he is fairly entitled to divide its honors with its original discoverers. Among the many Continental towns lighted with wood gas were Bayreuth, Coburg, Wurtzburg, Darmstadt, Kempten, Regensburg, Aaren, Landshut, Zurich, Giessen, St. Gallen, Ulm, Erlangen, Luzerne, Saltzburg, Innspruck, Passen, Rentlingen, Heilbronus, Trient, Solothurn, Augsburg, Munich, etc.

In some of these the product was enriched with gas from Boghead shale, grease, etc.; while in others the quality of gas from the firs of the great forest of Hagenau was found satisfactory to the consumers without the use of any enriching material.

Up to the year 1882, a number of the smaller towns on the Pacific slope of our own country were lighted with wood gas—among them

Virginia City, Nevada, Grass Valley, Oroville, Chico, Red Bluff, etc. Australian shale found great favor among them as an enricher soon after its importation began and before the development of California petroleum.

With the various modes of applying petroleum to the purposes of gas lighting, wood gas can never occupy any very important field in this country, though it would seem that in certain localities there must exist peculiarly cheap conditions of wood supply, and difficulties of transportation as to petroleum and naphtha, which would unite to render its adoption advisable.

Discussion.

Mr. Dunbar—At the Virginia City gas works I would like to know how much carbonic acid was contained in the gas, its specific gravity; also the pressure on the holder, and the illuminating power of the gas, that would enable it to be forced down 300 or 400 feet, and still give more pressure than was actually needed.

Mr. Smedberg—The carbonic acid was between 35 and 40 per cent. The initial pressure of the holder was not over 24 or 25 tenths. You must remember that this Australian shale gave us from 70 to 80 candle gas. There was a large dose of that in it, and a tremendous percentage of carbonic acid and carbonic oxide besides.

Mr. Dunbar—What pressure did you get at the lower end of the town?

Mr. Smedberg—I do not remember exactly, but I know that it lighted the town very satisfactorily. They lighted the down hill district as well as the up hill. They had about the same pressure in both the old and the new districts.

Mr. Dunbar—I do not see how that could be.

Mr. Smedberg—You must remember that in the wood gas alone, in which there is 35 or 40 per cent. of carbonic acid in addition to the carbonic oxide, you get a very heavy product. As a practical fact, I know that for four or five years they lighted Gold Hill in that way.

Mr. Thompson—If there was 30 or 40 per cent. of carbonic acid in the gas what elements had you left to burn.

Mr. Smedberg—They had an enormous dose of illuminants—in the first place from their pitch pine and next from the Australian shale.

Mr. Thompson—What was the illuminating power of the gas?

Mr. Smedberg—It was 16 or 17 candles, with a specific gravity about equal to that of atmospheric air.

Mr. Dunbar—What would have been the illuminating power if it had not contained that carbonic acid?

Mr. Smedberg—From 45 to 50 candles.

Mr. Ferrier—I would like to ask where that large quantity of carbonic acid came from?

Mr. Smedberg—From the moisture and carbon in the wood. That is the trouble with the wood gas process. It is practically a water gas process on account of the large quantity of water contained.

On motion of Mr. Persons, the thanks of the Association were voted to Mr. Smedberg for his paper.

REPORT OF COMMITTEE ON FINAL RESOLUTIONS.

The President—Is the Committee on Final Resolutions ready to report?

Mr. Boardman—To my astonishment I found a few momenets ago that, with Mr. Butterworth and Mr. Thompson, I was on the committee of final resolutions. We have had to make them very short, but I hope they will be satisfactory.

Your committee on final resolutions beg leave to report that in their opinion the thanks of the Western Gas Association are due and should be tendered to the President, for his uniform courtesy in conducting the business of the meeting; to the Secretary for the well arranged and executed programme of proceedings; to the authors for the various papers presented for our consideration and digestion; and to the Committee of Arrangements for the successful procurement of comfortable quarters in this crowded city, and for the substantial entertainment which we hope to digest to-morrow night.

A. E. BOARDMAN,
I. BUTTERWORTH,
G. T. THOMPSON,
} Committee.

On motion of Mr. Lansden the report was accepted, and the resolution unanimously adopted.

Mr. Lansden—Before we adjourn I want to ask a question. Recently I examined some combination chandeliers for electricity and gas, and found, in a six light chandelier, a quarter inch pipe. I would like to know whether or not the manufacturers of combination chandeliers and fixtures are going for us in that kind of a way. It is certainly very unfortunate if they are; and it may work to the deteriment of the gas business. In this instance the casings were large enough to run wires down between the casing and the drop. I think it is a matter worthy our attention, and I would be very glad if the members of the Association would be on the watch, and next year state what their experience has been in that respect.

The President—Has any member any experience which he can give to Mr. Lansden, or any information with regard to the manufacture of combination gas and electric fixtures in respect to reducing the size of the gas passages?

Mr. Freese—I have seen those fixtures.

Mr. Tracy—I know a case where a three light fixture had a quarter inch pipe.

The President—It would be well to give this matter consideration and to let the fixture people know that we are after them.

Mr. Cathels—We are all interested in this matter. I mean to try to find a fixture that will give an equal show to gas and to electric light. The combination fixtures as a rule give the electric light from 50 to 75 per cent. advantage. If any manufacturer will produce a fixture that is really a combination fixture, giving equal benefit to both lights, I am sure that he will get the patronage of every gas man.

Mr. Tracy—I spoke about it to one fixture man who said that they had to use well insulated wire and coat it somewhere, or else a bigger casing. I told him I thought he ought to make a bigger casing.

APPOINTING COMMITTEE OF ARRANGEMENTS FOR NEXT MEETING.

The President—There is one more committee to be appointed, and as this committee is to operate next year, and during Mr. Jenkins' Presidency, I will call Mr. Jenkins to the chair and let him appoint the committee. I have the pleasure of introducing to you Mr. E. H. Jenkins, the President of the Western Gas Association.

Mr. Jenkins—I have already made one speech this afternoon and I do not think you want me to make another. The one other committee to be appointed is the Committee of Arrangements for the meeting in Cleveland next year. In appointing this Committee I wish to say to them—and I think in doing so I voice the sentiment of every member of the Association—that we do not ask them or their city to put up for us any elaborate entertainment. We have decided to go to Cleveland without any invitation from them whatever; and they are to feel that we come there on our own responsibilities, and that if we need any entertainment we will provide it for ourselves. With that explanation I name the Committee of Arrangements as follows:

M. S. Greenough, Cleveland, O.
D. R. Warmington, Cleveland, O.
C. R. Faben, Jr., Toledo, O.
Irvin Butterworth, Columbus, O.
Joseph R. Light, Dayton, O.

Is there anything else to come before the meeting? If not I wish to say, without any solicitation whatever, in behalf of the retiring officers, that we thank you one and all for your kind attention to-day, for your earnestness in carrying forward the proceedings at our meeting, and in helping us to carry through in so short a session what ordinarily takes the greater part of two days.

The Association then adjourned.

The Capital Invested in Gas Undertakings, and the Consumers of Gas.

[Communicated by Mr. Norton H. Humphrys, F.C.S., to the *Journal of Gas Lighting.*]

The amount of capital invested in the undertaking that supplies the neighborhood with gas, is not a matter of general interest to the gas consumer. The subject is not likely to occur to his mind unless something happens to direct his attention to it—such as a suggested purchase by the town authorities, or an application to Parliament for further powers. In that event, his interest is of an evanescent character, as in any other passing event; and he rarely realizes that there is an intimate connection between the capital expended and the price per 1,000 cubic feet that he is called upon to pay for gas at the end of each quarter. Yet it is a fact that the gas revenues have to bear a definite charge in the shape of standard dividends upon the nominal paid up capital of the company. This standard dividend, as averaged over the whole capital—share, debenture, and premium or non-dividend bearing—is not 12, or even 10 per cent., as many of the public (including some who are in a position to be accurately informed) would have us believe. It usually figures out to within a fraction of 6 per cent., and is rarely more than 8 per cent. Further, since the introduction of the auction clauses, whereby all new capital issued is sold by auction to the highest bidder, and the

premium realized passes into the capital account of the company, the average rate has been gradually falling; and also there has been a tendency to equalization as comparing one undertaking with another.

Other causes have also been at work. The old order of 10 per cent. dividends, new capital issued *pro rata*, and practically no competition—or, in other words, no necessity for reducing the price of gas—has passed away. Now we have sliding scales and auction clauses; a very real competitor in cheap oil; and a more largely vaunted one in electricity. The pretensions of the latter will always find acceptance as fact in certain quarters. And there is a certain feeling of unrest, as not knowing what science may bring forth. This is only a vague sort of sentiment; but nevertheless its operations are as evident as those founded upon established facts; and it has even invaded the precincts of the gas works board room. So that in place of the tendency to increase capital as fast as it was wanted (and occasionally a little faster), we find there is now every inducement to keep capital down. Fresh issues of capital are not made before they are wanted, and they are considerably less in proportion to the whole than the increase of business which necessitates them.

A great deal of trouble and expense have been incurred, for many years past, in the preparation of the annual parliamentary returns relating to gas undertakings. They are of value as works of reference to parties interested; and they usually come into evidence when questions of valuation are concerned. It would be interesting, however to know how many copies of them are purchased in a year, and especially by persons not directly interested in gas undertakings. This in passing. With a word of appreciation as to the generosity of the Government, in providing these statistics, which come in excellently for the present purpose, I would proceed to notice the fact that they afford interesting information on the question of capital and its relation to the consumer of gas. Given a fair average rate of dividend—say, 6 per cent.—the amount of capital as compared with each 1,000 cubic feet of gas sold per annum, has a direct bearing upon the charge to the consumer. If the capital stands at 10s. per 1,C00 cubic feet sold, a tax or loading of 6 per cent. on that sum—viz., 7.2d—is sufficient to provide the dividend; and accordingly, the working expenses, repairs, etc. (or, in other words, the net cost of the gas, *plus* 7.2d.), represents the sum for which gas can be sold by the particular undertaking. But if, instead of standing at 10s., the capital stands at 30s. per 1,000 cubic feet, the loading must be increased to 1s. 9.6d. in order to pay the dividend. Given the same actual net cost of making and distributing the gas, the consumer must pay 1s. 2½d. more in the second case than in the first. Or, taking the net cost at 2s., the charge to the consumer will be practically 2s. 8d. in the first case, and 3s. 10d. in the second. Perhaps it should be mentioned here that this is no fictitious case, exaggerated for the purpose of illustrating the argument. An examination of the parliamentary returns will show that there are companies laboring under the disadvantage of a capital account running as high as 30s. per 1,000 cubic feet of gas sold per annum. These examples are sufficient to show that the expenditure of capital has a very real interest to the consumer, and further, that since the auction clauses have tended to reduce the actual *average* rate of dividend paid on the capital invested, the actual capital concerned is of much more importance than the nominal rates of dividend paid.

The circumstances under which the expenditure of capital is incurred vary so greatly in different districts, that it is impossible to lay down any very definite rule about the expenditure as compared with the production. The actual cost of the retorts, purifiers, gasholders and buildings is comparatively simple; but the matter is complicated by the cost of land, legal and other charges, payments for goodwill in buying up existing undertakings, and a widely varying extent of mains, services and meters—apart from the question of carved or moulded stone work, fancy castings, ornamental painting and mosaic tiles, as compared with plain bricks and iron. Some believe in substantiality, space and elegance; and others, in the very cheapest arrangement that will do for the requirements. Then there is always a considerable margin of reserve capacity; and the extent to which this has been provided may be perfectly wise and judicious, or it may be quite the reverse. Yet after allowing for these and other considerations, one is scarcely prepared for the fact that the ratio of expenditure per 1,000 cubic feet of gas sold is as great as about one to five. The lowest proportion, in a selected list of about 50 undertakings taken from the returns for 1891 for undertakings other than those owned by local authorities, is about 7s., and the highest about 35s. If we come to figure out the cost of a large gasholder, or a large retort house, at per 1,000 cubic feet capability, the result comes out less than a smaller one. The same as regards distribution or office accommodation. Yet there are several provincial undertakings having a production of only 100 to 150 million cubic feet per annum, with a smaller capital account than obtains in London or our principal towns. Nor does locality appear to have any effect. The large and small capitals are fairly shuffled and distributed throughout the whole country.

The returns show most unmistakably that heavy capitals are a thing of the past. With the increase in consumption, and the addition of capital including an important proportion of premium or non-dividend bearing stock, and with improvements in apparatus of all kinds, there has been a very steady fall, year by year, in the proportion of capital per 1000 cubic feet of gas sold. This fall has been larger in the case of concerns that were loaded with heavy capitals at the first. Taking the year 1880, when the parliamentary returns were commenced, the lowest is about 13s. and the highest something over £2. During the twelve years there has been a great advance in the demand for gas. In some districts the increase has been double or even threefold; leading to a suspicion that new districts have been taken on, or that the business was in other ways imperfectly developed at or previous to 1880. But leaving out accretions due to new business, the normal rate of increase during that period is not less than 50 per cent. This is an instructive commentary, by the way, for those who, at about the beginning of the period under consideration, talked confidently about gas having reached its zenith, having passed it, and having started toward extinction.

With these reductions both in regard to proportion of capital invested, and to the average rate of dividend paid, the advantage offered by the transfer of the undertaking to the local authority grows less and less. The latter body have no power to alter the actual net cost of the gas. At best, they can only promise the saving of the directors' fees, and a little reduction in establishment expenses, the whole of which does not amount to over a penny or so per 1000 cubic feet. It is questionable whether these advantages (such as they are) are not attended with counterbalancing drawbacks. But the main feature of the economy is to be looked for in the item of charges for dividend or interest. With an average dividend of 10 per cent. all round, there is some margin for saving. The corporation may be able to negotiate such terms as will enable them to work with a less sum in the form of interest on the loans acquired for the purchase than that represented by the dividends paid by the company. But when the average dividend is brought down to 6 per cent., the company could not be compelled to sell at terms that would leave any prospect of such a reduction. Of course, this is speaking from the gas consumers' point of view only. There is the ratepayers' aspect of the question, which in most cases is the dominant one governing not only the circumstances of the purchase, but also the subsequent administration of the undertaking.

Losses in Transmission of Steam.

The *Colliery Engineer* notes that Prof. R. C. Carpenter, of Sibley College, Cornell University, made an interesting test on a line of steam pipe at the Lehigh Valley Railroad Company's coal storage plant at Plainfield, N. J., on February 17th, and practically determined the value of a good steam pipe covering.

At South Plainfield the surplus coal of the Lehigh Valley system, destined for the New York market, is unloaded by the Dodge System of coal handling machinery, stored in enormous conical piles, and then reloaded, as the state of the market demands. The coal is distributed on either side of the track for a distance of 1,500 feet. The unloading and reloading machinery is heavy, and requires in each case enormous power which is only in occasional use, so that the problem in this case is, most efficient distribution of power to the various coal handling plants. The system adopted was that of independent engines, provided with steam from a central boiler plant. The engines are operated only when the machinery to which they are connected is required. At other times no steam is supplied them.

The steam is conveyed to the engines in piping which is protected from heat radiation by the Wyckoff covering as now manufactured at Elmira, N. Y., by A. Wyckoff & Son. It consists of two concentric octagonal pipes, each built of 1-inch plank, and separated from each other by a very thick layer of waterproof paper.

The steam pipe at this plant is not buried in the ground, because of the wet character of the soil and the difficulty of securing proper drainage, but is left on top of the ground, and protected by a rough wooden box construeted of 2-inch plank. The outer box is far from tight, and air enters freely at numerous cracks and holes, so that, except as a mechanical protection for the inner wood covering, it cannot be considered of great value, and is certainly inferior in non-conducting properties to a covering of earth.

The boilers for the plant are six in number, and are a vertical type of plain tubular boiler. They are 6 feet in diameter, 18 feet high, and con-

tain 316 flues, each 3 inches in diameter. Four of the boilers are sufficient to operate the plant at its usual capacity.

The expansion of the line is poorly provided for, there being one plain expansion joint and two offsets. The expansion joint is badly out of line, is located near the boiler house, and is practically inoperative. The result is, that when a given line is heated up, a great increase of length occurs, which is permitted by the branches leading to the various engines, but which, nevertheless, induces severe strains both in the pipe itself and in the outer wood covering.

In making the test, Prof. Carpenter was assisted by Messrs. Dunn and Mack, of the class of 1893, in Sibley College. The duration of the test was 8 hours.

The line tested was 747 feet long, consisting of 250 feet of 6-inch, 106 feet of 5-inch, and 391 feet of 4-inch pipe, having a radiating surface of 1,057.5 square feet.

The engine was a 12″ by 16″, running with a piston speed of about 600 feet a minute, thus requiring, when cutting off at one third stroke, a velocity of the steam of about 60 feet per second in the 4 inch supply pipe. As this pipe was 391 feet long, more reduction in pressure was anticipated than was actually found. The actual reduction varied from 5 to 7 lbs., averaging 6 lbs.

The general method of testing adopted, was such as to give information, first, as to the amount of water in the steam as it entered the steam pipe; second, the amount of water in the steam as it reached the engine; third, the amount of water collected at intervening drips; fourth, the total amount of steam used; fifth, the fall in pressure between the boilers and the engine. These determinations were made as follows: The amount of water in the steam was determined by a throttling calorimeter, the sample of steam being drawn, in each case, from a vertical pipe located close to a bend from a horizontal, and collected by a ½ inch nipple extending past the center of the vertical pipe. The drip was caught at places which had been provided in the pipe, and was weighed from time to time.

The boiler gauge was removed from boiler No. 1, and a test gauge, which had been compared with the standard mercury column at Sibley College, and found to have an error of 2 pounds, was put in its place. Boilers No. 1 and No. 2 are connected by a large steam drum, and subjected to the same pressure. It was found by this comparison that the test gauge read the same as the gauge on boiler No. 2, and that it read 2 pounds higher than the gauge on boiler No. 1. This would indicate that boiler gauge No. 1 was correct, and No. 2 and the test gauge 2 pounds high. The barometer readings were taken with an aneroid which had been compared with a mercurial barometer.

Prof. Carpenter prepared a table of summaries and a diagram of the results of the test. A study of these shows that the loss was sensibly constant during the run. This is clearly shown by the fact that any increase in the amount of steam flowing through the line had the effect of decreasing the percentage of moisture at the engine.

The total loss per hour was equivalent to that required to evaporate (36 + 45.1) 81.1 pounds of water from a temperature of 212° F., to a pressure of 70.1 pounds by gauge. This is equal to (81.1 × 893) 72,322 B. T. U. The average steam pressure was 70.1 pounds by gauge, its temperature 313.6° F., the average outside temperature 16.63° F.; hence the difference of temperature was 297°. The loss for each degree difference of temperature becomes (72,322 ÷ 397) 244.2 B. T. U. per hour. The total radiation surface was 1,057.5 square feet, hence the loss in B. T. U. per square foot per hour was 0.2315 per degree difference of temperature.

The loss for a naked steam pipe under the same conditions would have been 2.93 B. T. U. per square foot of surface per hour, or the loss of the covered pipe is reduced to 7.87 per cent. of the bare steam pipe. The entire loss for the transmission is equal to the coal needed each hour to evaporate 81 pounds of water, which can be approximately stated as 10 pounds, since the evaporation of 8 pounds of water by 1 pound of coal is not an unreasonable assumption. Expressed as a percentage of maximum capacity of the line, this loss will not exceed 1 per cent., although it reached 2.3 per cent. of the maximum heat transmitted during the test.

Throughout the test the total loss expressed in pounds of steam remained practically constant. This has the effect of decreasing the percentage of moisture present in the steam, when the total amount of steam passing through the line increased. The parallelism of the two lines, on the diagram, representing the pressure at the boiler and at the engine, nearly 750 feet distant, was remarkable.

It is easily possible to calculate the surface required to condense one pound of steam from the data given in the tests. Thus, to change one pound of steam at atmospheric pressure, into water, at a temperature of 212°, 967 B. T. U. must be absorbed.

The loss in transmitting power by any system is largely constant, and hence, when the power is greatly increased, the percentage is correspondingly reduced. The following estimate is based on the transmission of 100-horse power 1,000 feet.

Method of Transmission.	Percentage of Loss.
Line Shafting—	
Loss by friction.....(average 25)	15 to 40
Electricity—	
Loss in transforming from mechanical to electrical and vice versa.....	20 to 30
Line loss.....	2 to 5
Total loss.....	22 to 35
Conveying steam—	
Naked steam pipe (still air).....	37.6
Pipe covered with solid wood and earth	11.2
Pipe covered with Wyckoff's covering.....	4.2

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Thomas G. Lansden has resigned the position of Engineer and Superintendent to the Washington (D. C.) Gas Light Company. Mr. Lansden will enjoy a well-earned vacation, that will likely terminate towards the close of the coming fall, when we expect to be able to report that he is again in active duty. Is certain gas history to be repeated in Washington?

We are informed by "Observer" that there is no foundation whatever for the report that ex-Governor Ames is to succeed Mr. J. Edward Addicks in the Presidency of the Bay State Gas Company. Meanwhile there is color for the belief that there is much friction between certain interests in the Company that were hitherto fairly harmonious.

On the 21st inst. a special meeting of the shareholders in the Jamestown (N. Y.) Gas Company will be held for the purpose of determining whether the capital stock of the Company shall be reduced to $45,000. The present capitalization is $100,000.

The following from a Pawtucket (R. I.) newspaper carries its own explanation—an explanation that shows Superintendent Stiness to be still a factor in the ranks of the liberal. "For one thing at least the people of Pawtucket are to have occasion for thanks, and that is cheaper gas. The good news will not be generally known until this issue of the *Telegram* reaches the people, but the few who have learned of it feel like calling a mass meeting and inaugurating a jubilee. The price heretofore charged for gas has been $2 per 1,000 feet, with a rebate of 10 per cent. on all bills paid within 30 days after being presented, but under the new order sent out from the office of the Company on June 1st, the price charged on and after July 1st will be $1.60 per 1,000, with a rebate of 10 cents per 1,000 on all bills paid on or before the 24th of the month in which they are presented. Mr. Samuel G. Stiness, the genial Superintendent of the Company, smiled upon the *Telegram* representative as he remarked: 'Twenty-five years ago, June 1, I began my duties as Superintendent of the Company, and we are going to celebrate the silver anniversary by reducing the price of gas.' In these days of mandamuses, holdover governments, prorogueing, etc., news like the above is sweet to hear."

The Worcester (Mass.) Consolidated Street Railway Company has placed the contract for its new car house with the Berlin Iron Bridge Company, of East Berlin, Conn. The new building will be 95 feet in width and 290 feet in length, entirely of brick and iron.

The following letter explains itself:

Philadelphia, Pa., June 5th, 1893.

To the Editor American Gas Light Journal: In your issue of June 5th, under the head of "Briefly Told," referring to residuals, it is claimed that it is owing to the cleverness of the vampires who manage the tar trust that the price is so low. I would like to correct that statement, as I am in the tar business and have been for several years. In the first place, there is no so-called "Tar Trust" or combination of any kind; neither is there any understanding of any kind or character among the tar distillers as to price of tar or any of its products. The Company I am with can buy tar in any city in the United States and sell its products wherever a purchaser can be found. It is, therefore, an injustice to the tar distillers to prejudice the gas companies against them. The price of tar to-day in the United States is governed by the market price in London, and that city also governs the price of the products of tar.

You also state "That foreign tar cannot be profitably laid down here in competition with American tar on the basis of four cents per gallon for the latter." Whether tar can be laid down here profitably or not makes little difference, if it is sold here on a four cent basis or less; and that is what is being done. If the American Association, of which I have the honor to be a member, or the Ohio Association desire to obtain any information regarding the tar business from a tar distiller's point of view, which would lead them to a fair consideration of the subject, and thereby advance their own interests, and at the same time not crush out the tar distiller, who has worked for years to build up a trade, which otherwise would have been, to a great extent, undeveloped, I repeat, if I can be of any service to either Association, I will be pleased to have them communicate with me. In the meantime, I hope you will give this the same prominence you have given "Briefly Told." Very respectfully yours, G. W. ELKINS.

AT a special meeting of the Southbridge (Mass.) Gas and Electric Company it was determined to increase the capital stock to $50,000 from $40,000, the additional stock to be disposed of at auction. The money thus raised is to be expended on plant betterment, the major portion of it going towards refitting the Company's electric equipment.

THE proprietors of the Framingham Gas, Fuel and Power Company, of South Framingham, Mass., have notified the residents that on and after July 1st the rate to those who use 50,000 cubic feet per month in gas stoves will be 40 cents per 1,000. The gas supplied by this Company is a non-illuminating water gas, the gross rate for which is 90 cents per 1,000, with 16⅔ per cent. off for payment before the 15th of the month, with a further lower net rate of 60 cents per 1,000 for all gas used in cooking and heating stoves. According to the current report of the State Board of Gas and Electric Light Commissioners the average price received by the Company for all gas sold in 1890 91 was 58 cents per 1,000, while in 1891-2 the average selling price was 51 cents per 1,000.

THE Hartford (Conn.) *Post* of recent date has the following to say respecting the bill now before the State Legislature, under the provisions of which the municipal authorities of the various cities and towns of Connecticut are empowered to engage in the business of supplying artificial light on public account—brief mention of this measure was made in the last issue of the JOURNAL: "The act permitting any city, town or borough to construct, purchase, lease, establish and maintain within its limits one or more plants for the manufacture and distribution of gas or electricity, for furnishing light for municipal use and for the use of such of its inhabitants as may require or pay for the same, has 18 sections, comprising about 19 pages of printed matter. It is now at the foot of the House calendar, and it is said that another substitute will be prepared. The subject is one of the most important in these times of economic advance, and for that reason it is improbable that the bill will pass; but if it does become enacted into the laws it is such an eminently conservative bill, and protects so thoroughly what are called 'vested rights,' that most of the radical members of the community will be disappointed. Section second provides that in cities the authority shall not be exercised until a vote for that purpose shall have been passed by each branch of its City Council, by a two-thirds vote, and received the approval of the mayor in each of two consecutive municipal years, and thereafter been ratified by a majority of two-thirds of the voters voting thereon at the annual municipal election. When such vote has failed to secure ratification, no similar vote shall be submitted for ratification until after the expiration of 5 years thereafter. The same process must be gone through with in town and borough meetings. Section four provides that such works may be paid for in 30 year 5 per cent. bonds, but no further indebtedness, except temporary, for running expenses, shall be incurred. Receipts shall be paid over to the locality in gross, and an appropriation regularly made by the authorities for the expenses. A local board of 3 commissioners shall be appointed by the mayor or selectmen, or warden and burgesses, none of whom shall hold other official positions, to serve for 3 years. They shall give bonds, shall manage the works, and decide all questions about the use of gas or electricity. Section 10 provides that that the price of gas or electricity shall not be changed oftener than once in 3 months. 'Any change shall take effect on the 1st day of the month, and the new price adopted shall, before the change shall take effect, be advertised at least one month in some newspaper published in the city or town or borough where the plant is, and if none shall be published therein, then in some newspaper published in the county where the plant is. Such price shall not be fixed on a basis of less than a net profit per year of 5 per centum on the cent (in which shall be included interest at the rate of 4 per centum, or at the rate at which the bonds aforesaid shall have been issued) of the investment in plant made by the city or town or borough, and also depreciation of the plant at not less than 5 per centum per annum of its cost. And the price shall not be greater than shall allow a net profit of 8 per centum per annum to the city or borough on such cost. In fixing such basis on which to establish the price to persons and corporations, the gas and electricity used by the city or town or borough shall be charged to it at cost.' Section 12 provides that if there is an existing plant it must be bought, if not on private terms, then on terms fixed by the Superior Court."

THE improvements on the plant of the Elkton (Md.) Gas Light Company are about completed, and the proprietors are pleased with the celerity with which the contractors carried out their agreements. A determined effort will be made this season to put out a good number of gas cookers.

AN order was recently passed by the Council of Worcester, Mass., requesting the Mayor to petition the Board of Gas and Electric Light Commissioners to order a reduction in the price for gas charged by the Worcester Gas Light Company, the order also to provide for an increase in the illuminating value of the gas.

THE second part of this order—an increase in the candle power of the gas supplied—looks to be a trifle on the unfair side; for the lighting value of the Worcester Company's gas, according to the returns of the Commissioners during the year 1891-2, averaged 19.51 candles—a very good candle power, especially when the same is compared with the light emitted by a 16 candle power incandescent electric lamp of the Worcester variety.

AT the annual meeting of the Peoria (Ills.) Gas Company the following officers were elected: Directors, Leslie Robison, M. Henebery, Peter Coffey, Wm. A. Herron, Thomas Coffey, Matt. Griswold and Matt. Farrelly; President, Thos. Coffey; Secretary, Matt. Farrelly; Treasurer, M. Henebery; Superintendent, Peter Coffey.

A CORRESPONDENT at San Francisco (M. A. S.) forwards the following: "The Board of Supervisors met in committee of the whole the last week in May to consider the question of gas and electric light rates. Some time ago the Board adopted a resolution calling upon the gas and electric light companies to compile and file with the clerk of the Board all possible data regarding the receipts and expenditures of the different companies. The object of the resolution was to get as much information as possible, in order to have some basis for a regulation of rates. The Board first met in executive session, and for over an hour listened to Attorney Mitchell and discussed the entire situation. Later, the Board went into open session, when Attorney Thomas B. Bishop and Mr. J. B Crockett, representing the San Francisco Gas Light Company, appeared. Mr. Bishop first addressed the committee and stated that he did not wish to occupy much time, as there were only two propositions which he would discuss. The first was that the Board had no power to regulate gas rates, and the second was that the Company was not in a position to stand any reduction of rates at present. He said that the Gas Company does not wish to be placed in the position of being subject to a regulation that should not exist and had no foundation in law. With the water question the Board had jurisdiction, as such was expressly conferred by the State Constitution. The Constitution names the Board as the tribunal which is to fix the rates annually, and prescribes the method of regulation, but in the case of gas it is different. No such jurisdiction is given, and the Constitution is silent on the subject. There is no prescribing of the method of regulation and no fixing of a tribunal. In conclusion, Attorney Bishop claimed that the present rates were fair and just, but said that Mr. J. B. Crockett could speak better on this for the Board's enlightenment. Mr. Crockett followed with a long address, in which he said that his Company had $8,000,000 invested in gas property and employed 625 men, whose wages amounted to $500,000 a year. Some of the men had been employed for 30 years and got the same wages as when gas was $7.50 a 1,000 feet. Mr. Crockett next stated that coal was very high here, and only English or Australian coal could be used on account of the great amount of carbon required. The freight on coal from the East was too great. He claimed that his Company paid from 30 to 33⅓ per cent. more for wages than Eastern companies. Then there was the freight on pipe and gas fittings, all of which had to be brought from the East. The Gas Company's representative next compared the prices of gas in other cities with San Francisco, and made the claim that, considering higher wages, dearer coal and heavy freight for material, the gas in San Francisco at $2 per 1,000 was cheaper than any other place in the United States. It was his firm opinion that any reduction of the present rate would greatly injure the

Company. The Board took the matter under advisement at the conclusion of Mr. Crockett's address. If it insists that it has jurisdiction to regulate gas rates the Company will carry the matter to the Supreme Court.

THE German *Journal of Medicine*, of April 27, 1893, published a circular from the Ministry of Clerical, Medical, and Public Institutions in Berlin to the officials of the Universities, Clinics, etc., in a body. This circular states that several experiments are being made with the Auer lamp (known in this country as the Welsbach) in order to form an opinion as to whether, and to what extent, it is adaptable for use in public buildings, auditoriums, laboratories, clinics, and so on. The above designated officials point out that they can obtain five times more lighting capacity from gas by the use of the incandescent gas lights (Welsbach mantles) than they can with the Argand burner; and with considerable economy in the use of gas they can still get three times the lighting capacity. Further, that the incandescent gas light burns evenly and steadily; that the air in the room remains pure; that health is not impaired by its use; that, owing to its white light, it is as easy as with the electric arc light to distinguish plainly all the other colors which are found in important operations and researches; finally, that it had proved itself adaptable for microphotography and work with the microscope. After enumerating the above and still other advantages of the mantle, the circular concludes as follows: "After all this, the incandescent gas light can be thoroughly recommended for improving the gas lighting of the Universities, institutes, clinics, etc. In many cases the incandescent gas light makes a suitable substitute for the electric light, and causes the latter to be dispensed with. I would respectfully ask you hereafter to please have the incandescent gas light fitted up wherever suitable. The expense incurred can form part of the current expenses. It is fortunate that the Auer mantle, which is the invention of a Viennese gentleman, Dr. Karl Auer von Welsbach, enjoys so pronounced recognition abroad."

AT a meeting of the shareholders in Rome (N. Y.) Gas Light Company the following officers were chosen: President, Thomas H. Stryker; Vice-President, Harmon G. Utley; Secretary and Treasurer, William R. Huntington; Superintendent, J. D. Higgins.

THE Portsmouth (N. H.) Company has made an agreement with Mr. John T. Langford whereby the latter will put in new mains in Middle, State, Congress, Islington, Daniel and Mulberry streets, the contract calling for the completion of the work by September 1st.

MR. CHARLES LONGMIRE, who has been acting as janitor at the Germantown station of the Philadelphia Gas Bureau, has been promoted to the position of inspector of fittings and pipes; and Mr. Thomas Brooks has been appointed a meter inspector at the same station.

CAPTAIN W. H. WHITE is back again at his desk on the top floor of 32 Pine. He is bright as a narcissus bloom, and has many a tale to tell of the beauties and glories of the Pacific Coast. In common with other voyagers who have inspected the new works of the San Francisco Gas Light Company, he pronounces the same a marvel of completeness.

SOME of the paternal government advocates located in and about Elmyra, N. Y., are urging the purchase by the city authorities of the local water, gas and electric lighting plants.

THE Carondelet Gas Light Company, of St. Louis, Mo., is extending its mains, and will make some improvements this season on the carbonizing plant.

A REDUCTION to $1.70 per 1,000 cubic feet in the selling rate at Dover, Del., will shortly be announced.

LAST month the Seattle (Wash.) Gas and Electric Light Company was obliged to secure a temporary injunction against George Kinnear and others restraining them from disturbing a gas main on Main street, close to South Third. Defendants were putting in a foundation for a new building, and in carrying on their operations stripped the pipe, undermined its bed and refused to shore the line, claiming that the Gas Company was a trespasser. Argument to cause the injunction to be made permanent was heard before Judge Langley, on May 31, and the Court issued a decree in favor of plaintiff.

THE proprietors of the Bayonne and Greenville (N. J.) Gas Light Company have ordered that hereafter the gas rate shall rule at $1.75 per 1,000 cubic feet, with a discount of 5 per cent. for prompt payment. This is virtually a reduction of 25 cents per 1,000.

MR. A. B. EILBECK, Superintendent of the Consolidated Gas and Electric Light Company, of Portchester, N. Y., is to be congratulated on his narrow escape from serious injury. While driving over the district, his horse became unmanageable, with the result that Mr. Eilbeck was thrown to the roadway. Fortunately, no bones were broken, and beyond a severe shaking up, the Superintendent sustained no other injury.

AT the annual meeting of the Portsmouth (Va.) Gas Company the following officers were chosen: Directors, R. C. Marshall, John H. Hume, C. R. Nash and John McIlhenny; President, R. C. Marshall; Secretary and Treasurer, H. L. Watts; Superintendent, H. H. White. It was determined at the meeting to authorize the making of a number of improvements on the plant this season.

THE proprietors of the Pittsburgh (Pa.) Gas Company have determined to extend their mains to the adjoining borough of Wilkinsburg.

A CORRESPONDENT at Salt Lake City informs us that Mayor Baskin has vetoed the gas and electric light franchise recently passed by the Council, mention of which grant was made some time ago in our columns.

THE Common Council of Santa Barbara, Cal., is considering the advisability of purchasing the plant of the local electric lighting company with a view to operating the same on municipal account.

THE Board of Trustees of the Cleveland Asylum for the Insane, at Newburg, Ohio, will receive proposals "for the necessary wiring, dynamos, engines, etc., for the installation of an electric lighting plant for said Asylum for Insane. Plant to have capacity of not less than 1,000 incandescent lights of 16 candle power, or their equivalent." The plans are on file at the office of the Superintendent, to whom all proposals should be forwarded. The competition will close at noon, 21st inst.

THE drinking fountain in front of Independence Hall, Philadelphia, was recently wrecked by an explosion of gas. For some time back the smell of escaping gas gave evidence of a leak in the mains, "and," writes our informant, "the gardener of the square, Wm. McGill, noticing a strong odor of gas around the fountain, lighted a match at the point where the odor was most pronounced. In an instant there was a bright flash and a loud report, and the tiger's head from which the water runs fell out on the pavement, narrowly missing McGill, who stood directly in front. When an investigation was made it was found that the gas had collected in the hollow base of the fountain, which is practically airtight; and, but for the strength of the latter, more serious trouble would have resulted from the explosion. As it was the weaker iron around the plate through which the water flows gave way, and the tiger's head upon it was hurled out like a cannon ball. The iron vase at the top, which weighs 500 pounds, was also jarred out of place, but fortunately did not fall."

The Condensation of Ammonia.

M. Frere, in a paper read before the French Association of Gas Managers, remarked that in spite of the lowering of prices, the condensation of ammonia remains a matter of importance to gas works. Sawdust is troublesome, and expensive to work. M. Melon has shown that there are two conditions which must be fulfilled; that the gas should be kept as cool as possible, and that it should be brought into contact with a surface as large as possible, and kept constantly moist. It is not necessary, however, to lower the temperature beyond 50° or 54°, or even 59° F., if the scrubber have sufficient capacity. This is shown by experiments made in practical working, of which M. Frere gave details. The apparatus employed was very simple, being only a Chevalet washer and a water-trickle pebble-column, supplied with from 53 to 88 pints of water per ton of coal distilled. When the temperature of the gas, on its admission to the Chevalet washer, rose from 57.7° to 58.2°, the ammonia remaining in the gas rose from 0.0284 to 0.070 grains per cubic foot. On putting up another pebble tower, in addition to the previously existing one, it was found, on working the water so that the temperature of the gas was never allowed to go beyond 57.2° F., that, even when the external air was at a temperature of 86° to 88° F. in the shade, there was never more ammonia in the gas than 0.0437 to 0.048 grain per cubic foot. In winter less water was used, but the gas contained only from 0.0262 to 0.0306 grain of ammonia per cubic foot.

Ammonia can thus be almost completely extracted by very simple means; and the only thing which needs to be looked after is the water supply to the pebble tower, which must be adjusted each day to suit the external temperature and the quantity of coal which is being distilled. The pebble columns only need to be cleaned about once a year. The tubular refrigerators must be cleared of naphthaline about once a fortnight by means of a steam jet. The moderate temperature employed prevents the deposition of tar in the washer or pebble column.

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AGENTS

NEW YORK.—AMERICAN NEWS Co., 39 and 41 Chambers Street.
Germany.—B. WESTERMANN & Co., of New York.

MONDAY, JUNE 12, 1893.

The Market for Gas Securities.

Consolidated sold off slightly during the week, the opening to day (Friday) having been made at 129 bid, as against 129½ last Friday. The continued ragged and uncertain state of the money market is no doubt responsible for the seeming indifference with which the shares are regarded, but investors can take it for granted that Consolidated to-day is worth 150 or more. Any fairly safe 7 per cent. stock ought to be worth 135, and the gilt-edged division (in which Consolidated certainly belongs) should be worth 15 points more. Equitable is quoted at 170 to 175, quotations that are merely nominal, for we doubt if a 300-share order could be completely filled at an average of less than 185. Mutual is reported at 139 to 142. Standard is dull and neglected. In Brooklyn shares there is no change, and the tendency of the quotations is for lower prices. The rumors of a gas war still are heard, but the probability is that not much blood will be shed. In the meantime, it is asserted by those in position to know, that consolidation is yet a strong probability. The Equity Gas Company's controllers are still pursuing their dog-in-the manger tactics, and we doubt if they themselves "know where they are at;" certainly, those on the outside are all in the dark. Chicago gas is weak at 69⅞ to 70. The regular quarterly dividend of 1¼ per cent. is payable on and after the 26th inst. Laclede common is at 17 to 17¼, and Bay State is decidedly lower at 16¼ to 16½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,
16 WALL ST., NEW YORK CITY.

JUNE 12.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	129	129½
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	139	142
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	35	40
Preferred	5,000,000	100	80	85
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	113
Citizens	1,200,000	20	—	107
" S. F. Bonds	320,000	1000	—	103
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	60
Fulton Municipal	3,000,000	100	128	—
" Bonds	300,000		102	—
Peoples	1,000,000	10	—	94
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	114	—
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	150	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	74	—
2d " " "	3,000,000	1000	54	—
Bay State Gas Co.—				
Stock	5,000,000	50	16¼	16½
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	69⅞	70
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	85	90½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	25	—
Bonds	600,000	1000	85	90
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	190	191
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	54¼	54¾
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			85	87
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	17	17¼
Preferred "	2,500,000	100	55	—
Bonds	9,034,400	1000	79½	80
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	30	—
" Bonds	240,000	100	103	—

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As Manager of Gas Works in Growing Town.

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940-3 B. MCADAM, Port Townsend, Wash.

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938-4 Spartansburg, S. C.

WANTED

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938-4

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940-tf Texarkana, Ark.